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JOHN R. MOHLER, Chief

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COTTONSEED MEAL FOR HORSES.

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OUTPUT AND USES OF COTTONSEED MEAL.

COTTONSEED MEAL is the ground cake left after the oil has been extracted from cotton seed. It is the most important by-product obtained in the manufacture of cottonseed oil, forming more than one-half of the total products obtained from the cotton seed. Approximately 2,500,000 tons of cottonseed meal and cake were produced in 1919, having a valuation of over $150,000,000. Of the quantity produced, somewhat more than 300,000 tons were exported, leaving more than 2,000,000 tons for home consumption.

Cottonseed meal is used as a fertilizer and as a feed for livestock. Its value as cattle feed is well established, but, owing to prejudices which have existed among horse feeders, cottonseed meal has not been held in favor as a feed for work stock. Feeders assert that it is likely to produce digestive disorders and that it can not be fed with safety. These claims, no doubt, have some foundation, but the harmful results have usually followed the use of a poor quality of meal or the feeding of excessive quantities.

Cottonseed meal is a heavy protein concentrate and its use as a supplement to the ration of work stock in supplying the protein content would be highly desirable, if safe. The test reported in this bulletin was conducted to determine to what extent cottonseed meal may be fed to horses with safety.

Monograph

PREVIOUS EXPERIMENTS IN FEEDING COTTONSEED MEAL TO HORSES.

Iowa State Bulletin 109 reports results of feeding trials lasting two years and in which concentrated feeds rich in protein were substituted for oats in rations for work horses. Among the conclusions drawn is the following:

"The health, spirit, and endurance of work horses were the same when fed corn with a moderate amount of * * * cottonseed meal as when fed a corn and oats ration, supplying a similar nutritive ratio.

North Carolina Station Bulletin 215 reports the results of experiments conducted to determine the possibility of using cottonseed meal successfully in rations for work horses, the form and combination in which it may best be fed, and the harmful effects, if any, resulting from its use. The author states that in each case where cottonseed meal was fed the coat of the animal became smoother and glossier than usual, that the spirit and endurance were not lessened, and that at the end of the experiment no harmful effects could be found as a result of feeding the meal. Farmers are advised not to feed draft animals cottonseed meal to the extent of more than 10 to 15 per cent by weight of the total ration.

The North Carolina Station Report for the year 1916 states the results of feeding cottonseed meal to work horses and mules at the Iredell, Pender, and Edgecombe substations. It was found that:

While cottonseed meal can be used in very limited amount, we can not, as a rule, induce a horse or mule to use more than 1 pound a day for any length of time. This 1 pound, however, has proved to be an economical addition to the ration and has also had much to do with maintaining the horses and mules in better condition.

THE EXPERIMENTAL FEEDING.

OBJECTS OF EXPERIMENT.

The objects of the experiment were:

1. To determine the value of cottonseed meal as a partial substitute for grain in a ration.

2. To determine the amount of cottonseed meal which can be fed with safety to work horses.

HORSES USED.

Sixteen horses were used in this experiment. With the exception of 4 purebred Morgans used for riding and driving, they were purebred and grade Percherons.

Of the 16 horses, 7 were not fed any cottonseed meal, thus acting as check animals. Where horses worked in teams it was planned to

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have one check horse and one meal-fed horse work together. The work performed involved practically all kinds of farm labor. The Morgan horses performed rather severe work under saddle or in harness, as they were ridden and driven at considerable speed when at work. The Percherons were used in all routine farm work, which at rush periods was very heavy. All the horses were in splendid condition at the beginning of the experiment except the 2-year-old draft filly Castanette, which was not very thrifty, owing to a defective molar tooth.

On account of the wide variety of work and the individuality of the horses, no fixed ration was used, but the animals were fed as cheap a ration as seemed practicable under the prevailing conditions.

FEEDS USED.

The horses seemed to dislike the taste and odor of cottonseed meal. To overcome this aversion the meal was mixed with wheat bran. Only fresh, finely ground, sweet cottonseed meal was used at all times and it was thoroughly mixed with the wheat bran. Whole oats were used as the principal grain in the ration, supplemented with the wheat bran and cottonseed meal. Because of the defective tooth the filly Castanette was fed ground oats instead of whole oats. The roughage fed was a good grade of timothy hay, and the quantity varied with the appetites of the animals.

The following table shows the weights of the animals and the rations fed at the beginning of the experiment, October 1, 1917:

Daily rations of horses at beginning of experiment.

Horse.	Weight.	Ration.			
		Oats.	Timothy hay.	Wheat bran.	Cottonseed meal.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds*	*Pound.*
Stanley	1,510	15	18	3	¼
Virginia	1,500	18	18	3	.....
Maude	1,520	20	20	3	¼
Myrtle	1,475	15	15	3	.....
Nell	1,443	18	20	3	¼
Queen	1,295	18	18	3	.....
Bertina	1,520	20	18	3	¼
Fauna	1,770	27	20	3	.....
Pet	1,325	15	16	3	¼
June	1,250	15	12	3	¼
May	1,315	15	16	3	.....
Castanette	1,260	15	18	3	¼
Gladstone	965	8	10	3	¼
Georgia	965	10	10	3	.....
Brown Bess	970	15	12	3	¼
Evarts	995	8	10	3	.....

DETAILS OF EXPERIMENT.

The quantity of cottonseed meal fed was increased from a quarter to half a pound at the end of the first week. The horses ate their rations satisfactorily, but did not seem to have a keen appetite for the cottonseed meal. Owing to their apparent dislike for the cottonseed meal, the rations remained unchanged until November 12, when the quantity of cottonseed meal was increased to three-quarters of a pound a day. This quantity was continued until December 8 with satisfactory results.

On December 9 the quantity of cottonseed meal used was increased to 1 pound a day, and that quantity was fed until January 20, when it was increased to 1¼ pounds. With this increase the animals were each receiving one-half pound of the meal in the morning and evening and one-quarter pound at the noon feed.

On February 10 the quantity of cottonseed meal was further increased to 1½ pounds each per day and on February 17 to 1¾ pounds each per day. The quantity of cottonseed meal remained at this point until March 10, when it was again increased to 2 pounds a day each and the wheat bran was taken out of the ration. Until that time the animals had not shown any great dislike for the cottonseed meal.

On March 24 and thereafter the horse Gladstone continually refused the meal, so the amount fed to him was gradually reduced.

On April 7 the mare Nell refused to eat part of the morning and noon feeds. She continued to do this until April 22, when she refused her grain ration altogether and had slight colic attacks for two days. The meal was then taken out of her ration for the remainder of the month.

From April 15 to 27 the mares Maude, Stanley, June, and Brown Bess showed some dislike for the meal and left small portions of it at times during that period, and their droppings were of a hard and dry nature. During the last three days of the month these mares regained their normal appetites and consumed their feed as earlier in the experiment.

Pet, Bertina, and Castanette consumed their rations better than the other mares, always having a good appetite and seeming to relish the meal, a manifestation not shown by the others. These three mares, with Brown Bess, thrived very well on the cottonseed meal, all eating 2 pounds a day each during May. On May 27 the first three animals were given an increase of one-quarter pound a day, so that they were receiving 2¼ pounds of meal a day, divided into three equal feeds. The mares ate this quantity of meal very well and did not show any ill effects from its consumption.

On May 19 and thereafter the draft mares were turned out on Sundays and did not receive any grain or cottonseed meal on those

days. Commencing May 22, they were turned out at night and were then fed only one-half as much roughage as before.

On May 27 the cottonseed meal was taken out of the ration for Gladstone and Maude, as these two animals continually refused to eat grain containing the meal.

On June 3 the amount of cottonseed meal for the mares Pet and Castanette was increased to 2½ pounds a day.

The mares Nell, June, and Brown Bess did not appear to relish their grain ration containing cottonseed meal during the first week in June.

The mare Bertina died on June 4 from an attack of pneumonia. She was getting 2¼ pounds of cottonseed meal prior to her death, and had shown no ill effects from consuming this large amount. The death of this mare was not attributed to the feeding of cottonseed meal.

Maude and Gladstone were started on the cottonseed-meal ration again on June 10, each being fed one-half pound a day during the week. Maude ate the ration satisfactorily, but Gladstone refused to eat it.

Commencing June 16, Maude's allowance of cottonseed meal was increased to 1 pound a day and the meal taken out of Gladstone's ration, as he continued to refuse a ration containing meal.

The mares receiving cottonseed meal ate their grain containing it very well during the latter half of June.

The following table shows the weights of the animals and rations fed during the last period of the experiment, beginning August 31, 1918.

Daily rations of horses during last period of experiment.

Horse.	Weight, Aug. 31, 1918.	Ration.				
		Corn.	Oats.	Oat hay.	Wheat bran.	Cotton-seed meal.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Stanley	1,425	.....	18	16	.....	2
Virginia	1,570	.....	12	8	3	.....
Maude	1,670	10	.....	10	.....	1¼
Myrtle	1,475	.....	12	8	3	.....
Nell [1]	1,485	.....	6	8	2	.....
Queen	1,410	.....	12	8	3	.....
Fauna	1,780	.....	15	10	3	.....
Pet	1,480	10	.....	8	.....	3
June	1,375	.....	16	16	.....	1½
May	1,390	.....	18	16	3	.....
Castanette	1,440	.....	12	8	.....	3
Gladstone	950	.....	10	10	2	.....
Georgia	960	.....	8	10	2	.....
Brown Bess	940	.....	10	10	.....	2
Evarts	940	.....	12	10	2	.....

[1] Foaled colt Aug. 28.

The mare Pet died on September 8 after a sudden attack of colic. After her death and one serious case of colic (Nell, referred to later), the feeding of cottonseed meal to all animals was discontinued for 30 days. During that period there was no noticeable change in the condition of the horses, nor were there any great changes in their weights.

The mare Nell was getting 1½ pounds of cottonseed meal up to August 28, on which date she gave birth to a foal. The feeding of cottonseed meal to this mare was discontinued at this time and was not resumed. This mare died September 25 from an attack of colic, and her death was not attributed to the cottonseed meal.

On October 6 the feeding of cottonseed meal was resumed, the amount of meal fed being 1 pound a day to each horse. It was thought that as the horses had eaten a much heavier ration of meal than that, 1 pound a day would have no harmful effects. On the second night after the horses were put back on the meal the mare Maude became very sick with a case of colic. As she had been quite healthy previous to that time, it was assumed that the cottonseed meal had caused the attack, so the meal was discontinued. She has shown no symptoms of sickness since.

On the sixth night after the renewal of the cottonseed-meal ration, the mare Stanley became quite sick with colic. The conditions in this case were very similar to those of the mare Maude. After having these two serious cases of colic, apparently caused from feeding the cottonseed meal, the feeding of this concentrate was discontinued, and the test ended October 13.

INDIVIDUAL CASES.

PET.

The young mare Pet was doing well on cottonseed meal and with Castanette was placed on a heavy cottonseed-meal ration. Pet received 3 pounds of cottonseed meal daily for 46 days. On September 7, 1918, she was taken with a severe case of colic and died the following morning. Before the attack she had been healthy and had shown no symptoms of colic. Post-mortem examination showed the stomach and intestines to be very much inflamed. There was a considerable quantity of cottonseed meal in the stomach and intestines. In this case indications were that death was due to the effects of cottonseed meal on the system. The harmful effects were not noticeable, however, until too late to prevent the loss of the mare.

NELL.

On September 25, 1918, the mare Nell had a severe case of colic from which she died the following day. This was one of many

frequent attacks to which she had been subject. A post-mortem examination showed malformation of the small intestine. A pocket had been formed in the intestine wall, which rendered the passage of food quite difficult. The frequent attacks of colic were no doubt due to stoppage of feed in the pocket of the intestine. At the time of death this pocket contained about a gallon of rather solid refuse. The death of the mare could not be attributed directly to the effects of cottonseed meal, as she had not been eating meal since August 28, at which time she gave birth to a foal.

SUMMARY OF EXPERIMENT.

The following table gives a brief summary of the experiment, showing the weights of various animals at the beginning of the test and the last weights, gain or loss in weight, quantities of cottonseed meal consumed, and a condensed statement of effects observed on each animal.

Summary of experimental feeding.

Horse.	Weight at beginning of experiment.	Final weight.	Gain (+) or loss (−) in weight.	Meal fed at beginning of experiment.	Meal fed at end of experiment.	Effects observed.
	Pounds.	*Pounds.*	*Pounds.*	*Pound.*	*Pounds.*	
Stanley	1,510	1,425	− 85	¼	2	Intermittent colic atttacks when fed large amounts of cottonseed meal.
Virginia	1,500	1,570	+ 70	.....	.....	
Maude	1,520	1,670	+150	¼	1¼	Refused ration containing over 1 pound of cottonseed meal.
Myrtle	1,475	1,475	.....	.....	.....	
Nell	1,443	1,485	+ 42	¼	1½	Died Sept. 25 from colic. Post-mortem examination showed malformation of small intestine. Death not attributed directly to feeding cottonseed meal.
Queen	1,295	1,410	+115	.....	.....	
Bertina	1,520	.....	.....	¼	.....	Died June 4, pneumonia. Death not attributed to feeding cottonseed meal.
Fauna	1,770	1,780	+ 10	.....	.....	
Pet	1,325	1,480	+155	¼	3	Died Sept. 8. Stomach and intestines highly inflamed from excessive feeding of cottonseed meal.
June	1,250	1,375	+125	¼	1½	No ill effects observed, although the mare would refuse to eat large quantities of the meal.
May	1,315	1,390	+ 75	.....	.....	
Castanette	1,260	1,440	+180	¼	3	No ill effects observed from feeding large quantity of meal.
Gladstone	965	950	− 15	¼	.....	Feeding cottonseed meal discontinued June 16, as he had acquired a dislike for it and constantly refused to eat a ration containing it.
Georgia	965	960	− 5	.....	.....	
Brown Bess	970	940	− 30	¼	2	No ill effects observed. The mare occasionally would leave a portion of the cottonseed meal.
Evarts	995	940	− 55	.....	.....	

CONCLUSIONS AND RECOMMENDATIONS.

Horses should be taught to eat cottonseed meal by giving them a very small quantity at first, about one-quarter of a pound a day, and increasing it very slowly, so that they gradually become accustomed to the taste and odor of the meal.

Cottonseed meal is a high protein feed and must be fed with care to horses and mules in order to avoid digestive disorders, to which work animals are subject.

When a horse shows dislike for the meal, the quantity fed should be reduced to the satisfaction of the individual.

Most horses show a dislike for the meal as soon as it becomes noticeable in their grain. Some individuals, however, relish the meal and can be fed larger amounts.

One pound a day per 1,000 pounds live weight is the most satisfactory quantity to feed. Although some animals will consume more with satisfactory results, it is not advisable to exceed this limit.

The most satisfactory method of feeding cottonseed meal to horses is by mixing it thoroughly with ground grains. This method, however, is not always practicable in the sections where cottonseed meal is most available.

Horses can easily separate cottonseed meal from whole oats or shelled corn if they form a dislike for the meal. This residue should not be left in the feed trough, as it ferments easily and has a disagreeable odor.

Mares which were fed cottonseed meal during the period of pregnancy did not show any ill effects from its consumption, nor were any ill effects noticeable on the colts when foaled. From observations in this experiment, cottonseed meal does not seem to prevent mares from becoming pregnant.

No apparently beneficial effects were observed on the coats of the horses receiving cottonseed meal. In some teams those receiving cottonseed meal had the better looking coats, while in other teams the horses not receiving the meal had the smoother and glossier coats.

The mares in this experiment thrived better and consumed their ration containing cottonseed meal more satisfactorily after they were turned out on grass. As cottonseed meal is not laxative in effect, there is a tendency for the feces to become hard and dry. The succulence supplied by pasture neutralizes this tendency and keeps the intestinal tract in better condition.

Feeding cottonseed meal in large quantities may result in serious digestive disorders, and even death in some instances. Post-mortem examination of one mare which died after receiving 3 pounds of cottonseed meal daily for 46 days disclosed an inflamed condition of the stomach and intestines. The indications in this case were that death was due to the effects of cottonseed meal on the system, and that the ill effects were not noticeable until too late to prevent the loss of the animal.

SUGGESTED RATIONS CONTAINING COTTONSEED MEAL.

The following daily rations have been prepared with a view of suggesting combinations of feed containing cottonseed meal, from which the feeder may derive rations that will meet his local needs. It should be noted that the following rations are for a horse weighing 1,000 pounds. Modifications of these rations should be made for heavier or lighter horses. For example, in order to meet the requirements for a horse weighing 1,250 pounds the rations suggested should be increased in accordance with the increase in weight, which in this case is 25 per cent. Roughly this would give the feed requirement for the heavier horse.

Daily rations for 1,000-pound horse, light work.

RATION No. 1.

½ pound cottonseed meal.
6 pounds oats.
14 pounds timothy hay.

RATION No. 2.

½ pound cottonseed meal.
7 pounds oats.
7 pounds oat straw.
7 pounds timothy hay.

RATION No. 3.

1 pound cottonseed meal.
6 pounds corn.
4 pounds cowpea hay.
10 pounds corn stover.

RATION No. 4.

1 pound cottonseed meal.
7 pounds corn-and-cob meal.
4 pounds cowpea hay.
10 pounds barley straw.

RATION No. 5.

1 pound cottonseed meal.
6 pounds corn.
14 pounds corn stover.

RATION No. 6.

1 pound cottonseed meal.
6 pounds corn.
6 pounds corn stover.
6 pounds sorghum fodder.

RATION No. 7.

1 pound cottonseed meal.
4 pounds rolled barley.
2 pounds wheat bran.
14 pounds barley straw.

RATION No. 8.

1 pound cottonseed meal.
6 pounds corn.
4 pounds millet hay.
8 pounds oat straw.

Daily rations for 1,000-pound horse, medium work.

RATION No. 1.

1 pound cottonseed meal.
9 pounds oats.
14 pounds timothy hay.

RATION No 2.

1 pound cottonseed meal.
2 pounds wheat bran.
8 pounds oats.
14 pounds oat straw.

RATION No. 3.

¾ pound cottonseed meal.
10 pounds corn.
4 pounds cowpea hay.
8 pounds corn stover.

RATION No. 4.

¾ pound cottonseed meal.
9 pounds corn.
4 pounds cowpea hay.
10 pounds sorghum fodder.

RATION No. 5.

1 pound cottonseed meal.
10 pounds corn-and-cob meal.
4 pounds cowpea hay.
10 pounds oat straw.

RATION No. 6.

1 pound cottonseed meal.
8 pounds rolled barley.
2 pounds wheat bran.
12 pounds barley straw.

RATION No. 7.

1 pound cottonseed meal.
2 pounds wheat bran.
8 pounds shelled corn.
6 pounds millet hay.
6 pounds oat straw.

RATION No. 8.

1 pound cottonseed meal.
3 pounds cane molasses (blackstrap).
7 pounds corn.
12 pounds crab-grass hay.

RATION No. 9.

¾ pound cottonseed meal.
9 pounds corn.
14 pounds mixed hay (timothy and clover).

Daily rations for 1,000-pound horse, heavy work.

RATION No. 1.

1 pound cottonseed meal.
12 pounds oats.
14 pounds mixed hay (timothy and clover).

RATION No. 2.

1 pound cottonseed meal.
2 pounds wheat bran.
12 pounds oats.
5 pounds alfalfa hay.
9 pounds oat straw.

RATION No. 3.

1 pound cottonseed meal.
2 pounds wheat bran.
10 pounds corn.
7 pounds cowpea hay.
7 pounds corn stover.

RATION No. 4.

1 pound cottonseed meal.
2 pounds gluten meal.
11 pounds rolled barley.
12 pounds timothy hay.

RATION No. 5.

1 pound cottonseed meal.
3 pounds peanut meal (ground with hull).
10 pounds corn-and-cob meal.
6 pounds cowpea hay.
8 pounds sorghum fodder.

RATION No. 6.

1 pound cottonseed meal.
2 pounds soy beans (ground).
11 pounds corn.
14 pounds corn stover.

PUBLICATIONS OF UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO HORSE RAISING.

Available for Free Distribution by the Department.

Breeds of Draft Horses. (Farmers' Bulletin 619.)
Colts: Breaking and Training. (Farmers' Bulletin 667.)
How to Select a Sound Horse. (Farmers' Bulletin 779.)
Breeds of Light Horses. (Farmers' Bulletin 952.)
The Feeding of Horses. (Farmers' Bulletin 1030.)

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HORSES SHOULD be taught to eat cottonseed meal by giving them a very small quantity at first, about one-quarter of a pound a day, and gradually increasing it as the animal becomes accustomed to the taste and odor of the meal.

Cottonseed meal must be fed with care to horses. If fed in large quantities it may result in serious digestive disorders and even death in some instances.

One pound of cottonseed meal per 1,000 pounds live weight is the safest and most satisfactory quantity to feed. Some horses will consume more with satisfactory results, but it is not advisable to exceed this limit.

To obtain best results, cottonseed meal should be fed by thoroughly mixing with ground grains. Only bright, high-grade meal should be used.

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